Claims:

1. A mixing device for use with a manifold in an injection molding apparatus, comprising:

a body, having a melt channel therethrough, said melt channel having a plurality of increasing sections which have an increasing cross-sectional area in a downstream direction, and a plurality of decreasing sections which have a decreasing cross-sectional area in a downstream direction, said increasing and decreasing sections alternating with each other.

2. A mixing device as claimed in claim 1, wherein said increasing sections smoothly increase in cross-sectional area.

3. A mixing device as claimed in claim 1, wherein said decreasing sections smoothly decrease in cross-sectional area.

4. A mixing device as claimed in claim 1, wherein said mixing device comprises mating channels formed in mating surfaces of a pair of blocks.

5. A mixing device as claimed in claim 1, wherein the surface of said melt channel is free of discontinuities in the axial direction.

6. A mixing device as claimed in claim 1, wherein the shape of said melt channel along an axial plane includes at least one surface in the shape of a sine wave.

7. A mixing device as claimed in claim 1, wherein the shape of the surface of said melt channel along any axial plane is in the shape of two sine waves.

8. A method of making a mixing device for use in a manifold in an injection molding apparatus, comprising:

(a) providing a first block of material having a first surface;

(b) machining a channel on said first surface of said first block of material, using a machining tool;

(c) during step (b), moving said machining tool and said first block of material relative to each other in a direction that is substantially perpendicular to said first surface, so that said machining tool machines at alternately increased and decreased depth in said first block of material;

(d) providing a second block of material having a second surface for mating with said first surface on said first block of material; and

(e) mating said first and second surfaces.

9. A method of making a mixing device as claimed in claim 8, wherein between steps (d) and (e), the method further comprises:

(f) machining a channel on said second surface of said second block of material, using a machining tool, and

(g) during step (f), moving said machining tool and said second block of material relative to each other in a direction that is substantially perpendicular to said second surface, so that said machining tool machines at alternately increased and decreased depth in said second block of material.

10. A method of making a mixing device as claimed in claim 8, wherein said machining tool comprises a hemispherical milling head.

11. A method of making a mixing device as claimed in claim 8, wherein, in step (c), said machining tool is moved along a sinusoidal path, so that a channel is machined having a sinusoidal shape along an axial plane.

12. A method of mixing a melt flow in a runner in an injection molding apparatus, comprising:

passing said melt flow through a channel having alternately decreasing and increasing cross-sectional areas.

13. A method of mixing a melt flow as claimed in claim 12, wherein the melt channel has a plurality of increasing sections which have an increasing cross-sectional area in a downstream direction, and a plurality of decreasing sections which have a decreasing cross-sectional area in a downstream direction, said increasing and decreasing sections alternating with each other.

14. An injection molding apparatus, comprising:

a manifold, said manifold having a melt source inlet, said manifold having a runner downstream from said melt source inlet, said runner having a mixing section, said mixing section having a plurality of increasing sections which have an increasing cross-sectional area in a downstream direction, and a plurality of decreasing sections which have a decreasing cross-sectional area in a downstream direction, said increasing and decreasing sections alternating with each other; and

a mold cavity block, said mold cavity block having a mold cavity downstream from said runner.

15. An injection molding apparatus as claimed in claim 14, wherein said manifold has a plurality of runners downstream from said melt source inlet.

16. An injection molding apparatus as claimed in claim 15, wherein said mold cavity block has a plurality of mold cavities downstream from said plurality of runners.

17. An injection molding apparatus as claimed in claim 14, further comprising a plurality of manifolds, each manifold having a melt source inlet and having runners, and further comprising a plurality of mold cavity blocks having mold cavities downstream from said runners.

18. An injection molding apparatus as claimed in claim 14, wherein said mixing section is positioned adjacent the downstream end of said runner.

19. An injection molding apparatus as claimed in claim 16, wherein a plurality of said runners have a mixing section as defined in 14, said mixing section positioned adjacent the downstream end of said runner.

20. An injection molding apparatus as claimed in claim 14, further comprising a nozzle having a nozzle channel, said nozzle channel being downstream from said runner and upstream from said mold cavity.

21. A manifold for an injection molding apparatus, comprising:

a melt source inlet;

a runner downstream from said melt source inlet, said runner having a mixing section, said mixing section having a plurality of increasing sections which have an increasing cross-sectional area in a downstream direction, and a plurality of decreasing sections which have a decreasing cross-sectional area in a downstream direction, said increasing and decreasing sections alternating with each other.

22. A manifold for an injection molding apparatus, as claimed in claim 20, wherein the manifold includes a split in said runner, whereby a melt flow in said runner is divided into a plurality of melt flows, and wherein said mixing section is positioned upstream of said split.

23. A method of mixing a coherent melt flow in a melt flow channel, comprising:

alternately constricting and expanding the cross-sectional area of said melt flow.

24. A method of mixing a melt flow in an injection molding apparatus as claimed in claim 22, wherein said melt flow is kept coherent throughout step (a).

25. A method of mixing a melt flow in an injection molding apparatus, comprising:

(a) alternately increasing and decreasing the average velocity of the melt flow through a melt channel in said injection molding apparatus.

26. A method of mixing a melt flow in an injection molding apparatus as claimed in claim 24, wherein said melt flow is kept coherent throughout step (a).

27. A method of mixing a melt flow in an injection molding apparatus, comprising:

(a) alternately subjecting said melt flow to an increasing and decreasing pressure drop, in a mixing portion of a melt channel in the injection molding apparatus.

28. A method of mixing a melt flow in an injection molding apparatus as claimed in claim 26, wherein said melt flow is kept coherent throughout step (a).

29. An injection molding apparatus comprising:

(a) an injection manifold having a plurality of manifold melt channels adapted to guide a melt flow, wherein at least a portion of at least one manifold melt channel has a generally circular cross-section in a plane perpendicular to the direction of melt flow and has a diameter in the plane that varies along the direction of melt flow;

(b) a plurality of injection nozzles in fluid communication with the manifold melt channels; and

(c) a plurality of mold cavities in communication with the nozzles.

30. An injection molding apparatus comprising:

(a) an injection manifold having a plurality of manifold melt channels adapted to guide a melt flow, wherein at least a portion of at least one

manifold melt channel has a melt channel axis and is configured to provide a melt flow rate that varies along the melt channel axis;

(b) a plurality of injection nozzles in fluid communication with the manifold melt channels; and

(c) a plurality of mold cavities in communication with the nozzles.

31. An injection manifold comprising:

(a) a manifold body, the manifold body having a plurality of manifold melt channels defined therein for guiding a melt flow;

(b) wherein at least a portion of at least one melt channel is a melt mixing portion having a melt channel axis and having a plurality of juxtaposed sections in series in a direction parallel to the melt channel axis, wherein each section has a different cross-sectional area than an adjacent section.

32. An injection molding apparatus comprising:

(a) an injection manifold having a plurality of manifold melt channels adapted to guide a melt flow, wherein at least a portion of at least one manifold melt channel has a melt channel axis and has a generally circular cross-section about the melt channel axis and has a plurality of portions along the melt channel axis having alternating increasing and decreasing diameters;

(b) a plurality of injection nozzles in fluid communication with the manifold melt channels; and

(c) a plurality of mold cavities in communication with the nozzles.

33. An injection molding apparatus comprising:

(a) an injection manifold having a plurality of manifold melt channels adapted to guide a melt flow, wherein at least a portion of at least one manifold melt channel has a melt channel axis and has a generally circular cross-section about the melt channel axis and has a diameter that varies along the melt channel axis;

(b) a plurality of injection nozzles in fluid communication with the manifold melt channels; and

(c) a plurality of mold cavities in communication with the nozzles.

34. An injection molding apparatus comprising:

(a) an injection manifold having a plurality of manifold melt channels adapted to guide a melt flow, wherein at least a portion of at least one manifold melt channel has a melt channel axis and is configured to provide a melt flow velocity that varies along the melt channel axis;

(b) a plurality of injection nozzles in fluid communication with the manifold melt channels; and

(c) a plurality of mold cavities in communication with the nozzles.